



# Cognitive Computing Vision and Use at NASA

Manjula Ambur

Lead, Big Data Analytics and Machine Intelligence Capability

NASA Langley Research Center

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# Comprehensive Digital Transformation

Big Data Analytics and Machine Intelligence Capability

## What is Cognitive Computing?

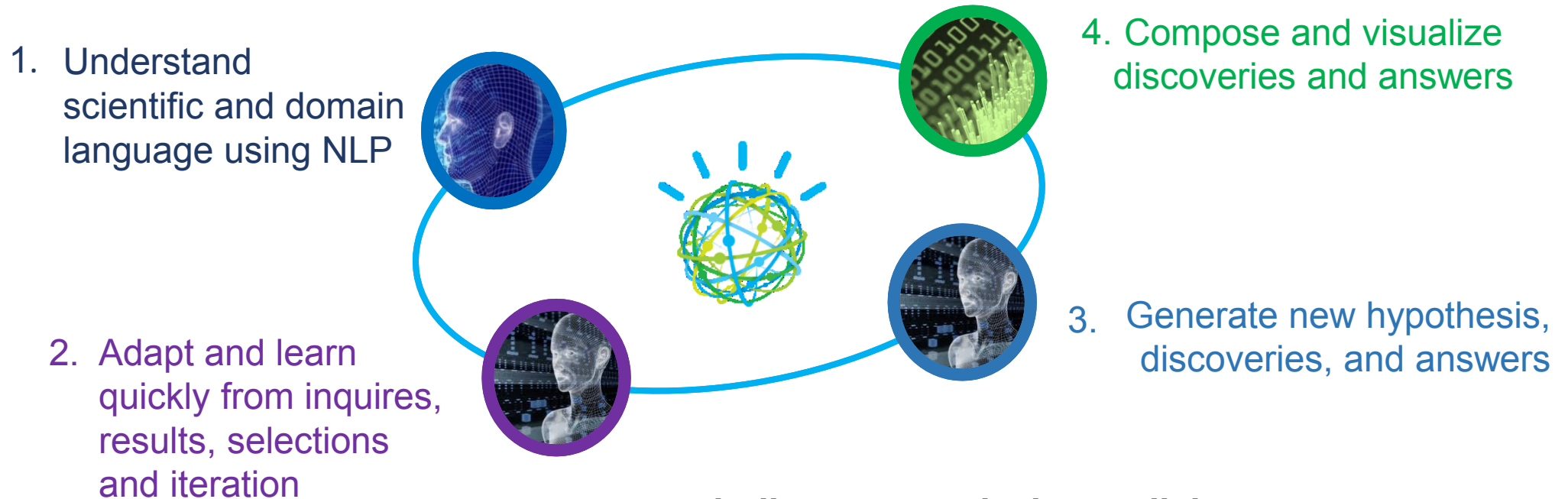
- Cognitive-based systems are able to build knowledge and learn, through understanding natural language, to reason and interact more naturally with human beings than traditional systems. They are also able to put content into context with confidence-weighted responses and supporting evidence.
- Cognitive systems continue to evolve as they ingest new information, new scenarios, and new responses. They reason in a way that is similar to human thinking so conclusions are obvious, transparent, and useful
- Cognitive systems amplify human cognition – Power of Human Machine symbiosis
  - Experts train system – takes time to teach new domains
  - Experts and system work together doing what they do best
  - Democratization of knowledge, expertise, and innovation
- Watson is an example of a cognitive computing system



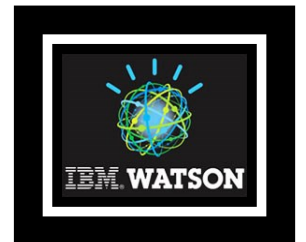
# Comprehensive Digital Transformation

Big Data Analytics and Machine Intelligence Capability

## Watson - How does Cognitive Computing work?



***...built on a massively parallel  
Big data scalable architecture***





# Comprehensive Digital Transformation

Big Data Analytics and Machine Intelligence Capability

## Cognitive Computing Vision for NASA

- Researchers/Engineers will have 'Digital Advisors/Experts' enabling greater scientific discoveries, and innovative systems designs and solutions
  - Able to quickly digest latest research innovations ; synthesize and makes sense of large volume of big data/information rapidly showing unobvious relationships, trends, and possible paths
  - Answer specific questions in all aerospace core disciplines showing evidence and traceability
  - Process experimental data and modeling and simulation and in real time with configurations and design predictions/optimizations
  - Design Assistant that is able to pull relevant facts out of documents and answer engineering questions using natural language and generate reliable answers
  - Deep analysis and mining of multimedia scientific and engineering information with associated data ,images and videos, and comprehends tables, numbers and mathematical equations
- Benefits to NASA
  - Be more innovative and competitive, and able to tackle harder challenges
  - Research that leverages world wide knowledge with optimal paths for discovery
  - Designs that are optimized solutions for aeronautics and space vehicles
  - Helps to optimize physical testing and modeling and simulation
  - Enables leadership with decision about most beneficial investments



# Comprehensive Digital Transformation

Big Data Analytics and Machine Intelligence Capability

## Why and How NASA Langley is using Watson Technologies

### Challenge: Expert's time needed to read and digest literature/manuals and make optimal decisions in a timely manner

- Each year, ~ **450,000** papers are published in scientific journals, along with 100,000s of technical reports, manuals, and patents
- On average, it takes a scientist/expert **160 minutes** to read a given paper/report
- NASA experts must dedicate **hundreds of hours** of their time each year – which is not feasible or practical – to digest and leverage this information/knowledge
- This results in a **slow progression of research and actions** due to the vast amount of information that must be reviewed to gain new insights and make new connections

### Watson Technologies Investigations at other NASA Centers (Langley is connected with all of these efforts)

- Ames Research Center: Feasibility study for 'Aircraft Dispatcher Assistant'
- Armstrong Flight Research Center: Investigating use for 'Pilot Assistant'
- Johnson Space Center: Investigating use 'Astronaut Health' and 'Robonauts'

### Knowledge Assistants *Using Watson Content Analytics (2013 -)*

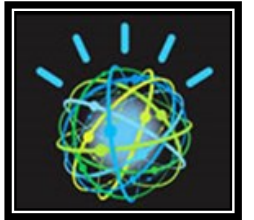
Analyze and digest large volumes of scientific information rapidly without 'reading', through the application of syntactical and semantic techniques

- Gain key insights and patterns
- Identify trends and connections
- Visualize experts networks

#### Successful Pilots Examples:

- Carbon Nanotubes research
- Autonomous Flight research
- Space Radiation research

Working to make it a Center capability



### Aerospace Innovation Advisor Prototype

*Using Watson Discovery Advisor (Planned for Feb – May 2016)*

Apply cognitive computing technologies that 'understand' massive amounts of information and enhance experts' cognitive abilities:

- Answer complex questions in seconds with confidence levels and traceability of evidence
- Show unobvious relationships within disciplines
- Show best possible paths for moving research forward and solutions for complex problems
- Enable rapid ideation, innovation, and decision making

Example Topics being considered for Prototype: Hybrid Electric Propulsion, On-Demand Mobility



# Cognitive Computing for NASA - A few Thoughts

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- As a research and design advisor using Watson Discovery Advisor – domain adoption and training is key
- As a Pilot Advisor to help with best possible solution paths in distress situations – can have speech interface like Siri
- Could be a co-pilot as cognitive computing technology adoption to our domain matures and we gain confidence
- More autonomous agents/robots/rovers for long Space travel and on other planets that can help us to do more things quickly and creatively
- As Advisors and/or companions for long duration space travel to Mars and to 'live' on Mars
- The Digital Advisor/Expert may not be possible immediately. Breakthroughs in understanding mathematics and tables, and mimicking human cognition, intuition are still required.
- With the current technology, we can move significantly by taking advantage of the power of human and machine cognition symbiosis that also helps NASA to better assess the path forward as the technology matures